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10 March 2011

Dear Mr Pruss,

Flood event of January 2011 – Wivenhoe Dam water releases – compliance with Manual

This is my response to your e-mail of 0926h on Monday 7 March 2011.

Request

You asked that I answer these questions:

1. The January 2011 Flood Event occurred between 6 January 2011 and 19 January 2011. Was the release of water from Wivenhoe Dam and Somerset Dam during the January 2011 Flood Event in accordance with *The Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam (Revision 7)*?

2. Based on the information contained in the draft Report, were there any aspects relating to the operation of Wivenhoe Dam and the operation of Somerset Dam during the January 2011 Flood Event **not** in accordance with *The Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam (Revision 7)*?

Opinion

In my opinion, your questions are to be answered as follows:

1. ***Question 1***

   The release of water from Wivenhoe Dam and Somerset Dam during the January 2011 Flood Event was in accordance with *The Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam (Revision 7)* with one possible exception. The decision to not implement strategy W2 at period 4, and possibly subsequent periods, does not appear to comply with the Manual flow chart on page 23. There is some ambiguity in the Manual requirements (see attached analysis).

2. ***Question 2***

   Apart from the exception under the preceding question, there were no aspects identified that were not in accordance with *The Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam (Revision 7)*. Information is not available on items 10, 11 and 13 under question 2 in the attached analysis.

The attached analysis supports my opinion.

Qualifications

My opinion is qualified as follows:

1. I rely on the relevant parts of the draft Report being factually correct;
2. The analyses and predictions given in the draft Report are taken as being reliable;
3. The draft report was received by me on Friday 4 March 2011. In the time available I have fully read and studied the *Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam (Revision 7))* – hereafter called the Manual - and the Executive Summary and Sections 1, 2, 3, 4, 5, 9, 10 and 11 of the draft Report. The other sections of the draft Report have so far been treated as reference material, referred to only as necessary. The appendices to the draft Report have been scanned as to content but have not been studied.
4. The Manual is ambiguous as to whether the operating strategy in any period of the flood event is to be based on actual or predicted lake levels. A reasonable interpretation of the Manual is that operations should usually move to the next strategy once the predicted lake level exceeds the threshold but the switch should certainly be made once the actual lake level exceeds the threshold. In other words the Manual gives the operators some latitude. My opinion rests on that interpretation.
5. There is ambiguity in the Manual regarding the conditions under which the management of Wivenhoe Dam releases should move to strategy W2. See my explanation in the attached analysis.
6. The question of whether the objectives of sub-section 3.1 of the Manual were applied optimally is inherently difficult because it involves value judgments and requires knowledge of the estimated potential consequences of alternative courses of action which could be followed within the constraints imposed by the Manual. Understandably that knowledge is not provided in the draft Report. That aspect of compliance with the Manual was not addressed in the attached analysis and is excluded from my opinion.

Yours sincerely,



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Dam Safety and Risk Consultant

Analysis of Compliance

The draft Report

The document – called the draft Report - which is the subject of this analysis is Seqwater, 2011, *January 2011 Flood Event – Report on the Operation of Somerset Dam and Wivenhoe Dam*, 2 March.

Question 1 – Was the release of water from Wivenhoe Dam and Somerset Dam during the January 2011 Flood Event in accordance with the Manual?

This analysis is primarily based on a review of the Flood Event Summary table of section 2 of the draft Report. That review was then checked against section 10 of the draft Report.

For each identified period of the flood event (twenty periods all told) this analysis could reasonably ask these questions:

1. were the operating strategies which were followed those indicated by the Manual?
2. were the releases from the dams in accord with those strategies? and
3. were the objectives of sub-section 3.1 of the Manual applied in the optimum way?

The third question arises because, in my opinion, the Manual has an implicit requirement that the application of the five objectives of sub-section 3.1 is to be optimized. For urban protection the optimality requirement is explicit. But bullet 4 of the "Conditions" for strategies W2, W3 and W4 implies a requirement for overall optimality. To properly judge whether optimality was attained is inherently difficult because it involves value judgments – giving relative weight to public safety risks, property damage risks, economic loss risks, public health risks, societal hardship and trauma risks, environmental damage risks. Moreover, such a judgment requires adequate knowledge of the estimated potential consequences of alternative courses of action which could be followed within the constraints imposed by the Manual. Understandably that knowledge is not provided in the draft Report. Consequently the third question is not addressed in this analysis. But a note is inserted under some periods to draw attention to the question.

The selection of a strategy for Wivenhoe Dam (the key case) is to be based on the lake levels, the flow at Lowood and the flow at Moggill (paragraph 3, sub-section 8.4).

There is a degree of ambiguity in the Manual about lake level – the issue being whether the strategy threshold levels are the predicted or actual lake levels. These facts are noted:

1. sub-section 8.4, paragraph 3 of the Manual states that the strategy is to be chosen according to actual and predicted lake levels – immediately creating ambiguity;
2. the flow chart on page 23 of the Manual refers to "likely" lake levels;

3. the strategy boxes – giving core conditions – refer to "predicted" lake levels;
4. the sub-strategies W1A to W1E can reasonably be construed as based on actual lake levels; and
5. the note in bold at the bottom of page 26 unquestionably refers to actual lake level.

A reasonable interpretation of the Manual is that operations should usually move to the next strategy once the predicted lake level exceeds the threshold but the switch should certainly be made once the actual lake level exceeds the threshold. In other words the Manual has given the operators some latitude. This analysis and my opinion rest on that interpretation.

Another ambiguity in the Manual relates to the selection of strategy W2. In paragraph 3 of sub-section 8.4 of the Manual it is said that selection will be based, inter alia, on peak flow rate at Lowood and peak flow rate at Moggill (both excluding Wivenhoe releases). A reasonable person would conclude that these are actual, not predicted, flow rates. The flow chart on page 23 refers to "likely" (meaning predicted to most people) flow rates at these places and does not say whether or not the threshold values include Wivenhoe releases. The note under the "Conditions" box on page 27 makes it clear that the aim is to keep the flow below 3,500 m^3/s at Lowood, from which it can be inferred that the flow chart question intends to include Wivenhoe releases. The conclusion is that the flow chart is to be applied using total flow at Lowood and Moggill to select the operating strategy. But the table at the bottom of page 27 then confuses the selection of a strategy because the first bullet limits the total flow at Lowood to the natural peak – if that peak is less than 3,500m^3/s. A reasonable conclusion is that the Wivenhoe discharge must be progressively reduced to zero at Lowood to coincide with the passage of the natural peak (if the peak is less than 3,500m^3/s) or for the period for which the natural hydrograph exceeds 3,500m^3/s. Did the Manual envisage such a tedious adjustment of Wivenhoe Dam releases? During the January 2011 flood event the operators thought not but that interpretation of the Manual is widely at variance with the flow chart. This is the ambiguity.

The draft Report does not provide estimates of total flow at Lowood. The Wivenhoe releases, which are given in the report, are likely to be attenuated by an unknown amount as they flow downstream. There are also complex timing issues related to changes in discharge at Wivenhoe – that is, when will the change register on the Lowood gauge? In the period by period analysis which follows, Wivenhoe releases are simplistically added to predicted peaks at Lowood – and at Moggill for some periods – but that is an entirely unrealistic indicator of the real peak flows at those downstream places.

There is an element of paradox around strategy W3. The conditions that indicate a shift to that strategy are that the lake level is expected to go above EL68.50, the total flow at Lowood is expected to exceed 3,500 m^3/s and/or the total flow at Moggill is expected to exceed 4,000 m^3/s. But, having implemented strategy W3, the objective is then to keep the flows at those places below those threshold discharge values so far as is reasonably practicable. If that objective succeeds the question arises as to whether the management of the releases should then revert to strategy W2 in accordance with the flow chart on page 23 of the Manual. In my opinion the

answer is "no" because strategy W2 is explicitly a transition strategy – having gone to strategy W3 the management of releases is to stay with that strategy until conditions indicate a shift to either strategy W4 or to Drain Down Phase. It is important to note that the Manual recognizes it may not be practicable to hold the flow at Lowood below 3,500 m^3/s and at Moggill below 4,000 m^3/s. Therefore flows in excess of the threshold values are not necessarily a non-compliance with the Manual.

The releases from Somerset Dam are less strictly prescribed than those from Wivenhoe Dam. There is a guide chart (page 40 of the Manual) but with a good degree of flexibility implicit in the Manual guidance. The operators clearly sought to keep to the guide chart so far as is reasonably practicable (see page 203 of the draft Report). In my opinion, the releases from Somerset Dam complied with the Manual.

In the analysis which follows, the flow charts on pages 23 and 38 of the Manual are the controlling guides and three values are all considered as follows:

1. actual value – designated "A";
2. predicted value without forecast – designated "P"; and
3. predicted value with forecast – designated "PF".

Period 1 of 20 – 0742h on 6 January to 0200h on 7 January - Strategy W1A/S2

Wivenhoe Dam

Factor	Range from Manual	Values	Conclusion
Lake level (m AHD)	67.25 to 67.50	67.31 to 67.52 (A) 68.2 (P) 68.7 (PF)	Complies on actual but not on predicted
Flow at Lowood (m^3/s)	Not applicable	Not applicable	Not applicable
Flow at Moggill (m^3/s)	Not applicable	Not applicable	Not applicable
Release (m^3/s)	< 110	Zero	Complies

Somerset Dam

Factor	Range from Manual	Values	Conclusion
Somerset lake level (m AHD)	> 99.0	99.34 to 99.55 (A) 99.7 (P) 100.1 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	67.31 to 67.52 (A) 68.2 (P) 68.5 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The Wivenhoe Dam releases complied with the Manual.

Note: Sub-strategies of strategy W1 appear to be based on actual lake levels in the Manual.

Period 2 of 20 – 0200h on 7 January to 0900h on 7 January - Strategy W1B/S2

Wivenhoe Dam

Factor	Range from Manual	Values	Conclusion
Lake level (m AHD)	67.50 to 67.75	67.52 to 67.75 (A) 68.2 (P) 68.5 (PF)	Complies on actual but not on predicted.
Flow at Lowood (m^3/s)	Not applicable	Not applicable	Not applicable
Flow at Moggill (m^3/s)	Not applicable	Not applicable	Not applicable
Release (m^3/s)	< 380	Zero	Complies

Somerset Dam

Factor	Range from Manual	Values	Conclusion
Somerset lake level (m AHD)	> 99.0	99.55 to 99.65 (A) 99.8 (P) 100.2 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	67.52 to 67.75 (A) 68.2 (P) 68.5 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Note: Sub-strategies of strategy W1 appear to be based on actual lake levels in the Manual.

Period 3 of 20 - 0900h on 7 January to 1500h on 7 January – Strategy W1C/S2

Wivenhoe Dam

Factor	Range from Manual	Values	Conclusion
Lake level (m AHD)	67.75 to 68.00	67.75 to 68.03 (A) 68.4 (P) 68.9 (PF)	Complies on actual but not on predicted.
Flow at Lowood (m^3/s)	Not applicable	Not applicable	Not applicable
Flow at Moggill (m^3/s)	Not applicable	Not applicable	Not applicable
Release (m^3/s)	< 500	Zero	Complies

Somerset Dam

Factor	Range from Manual	Values	Conclusion
Somerset lake level (m AHD)	> 99.0	99.65 to 99.94 (A) 100.3 (P) 100.6 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	67.75 to 68.03 (A) 68.4 (P) 68.9 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Note: Sub-strategies of strategy W1 appear to be based on actual lake levels in the Manual.

Period 4 of 20 - 1500h on 7 January to 1400h on 8 January – Strategy (W1D, W1E, W3)/S2

Wivenhoe Dam

Factor	Range from Manual	Values	Conclusion
Lake level (m AHD)	68.00 to 74.00	68.03 to 68.61 (A) 68.7 (P) 69.1 (PF)	Complies on actual and predicted.
Flow at Lowood (m^3/s)	No restriction	530+1,239=1,769 (P) 530+1,239=1,769 (PF)	Not applicable
Flow at Moggill (m^3/s)	< 4,000	770+1,239=2,009 (P) 940+1,239=2,179 (PF)	Complies
Peak release (m^3/s)	< 4,000	1, 239	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	99.94 to 100.44 (A) 100.5 (P) 100.6 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	68.03 to 68.61 (A) 68.7 (P) 69.1 (PF)	Complies on actual and predicted

Conclusion: It appears that the decision not to implement strategy W2 does not comply with the flow chart on page 23 of the Manual. There is uncertainty because of ambiguity in the Manual requirements. The releases complied with the Manual for strategies WID, W1E and W3.

Notes: It is not clear why strategy W2 was by-passed. Bullet 3 of "Background" for period 4 is not understood in terms of the Manual flow chart requirements. It seems clear that the question in the flow chart on page 23 of the Manual, concerning flow at Lowood and Moggill, should have been answered in the affirmative because predicted flow at Lowood of 530 m^3/s – plus the flow from Wivenhoe releases – would have been less than 3,500 m^3/s **and** predicted flow at Moggill of 770 m^3/s – plus Wivenhoe flow – would have been less than 4,000 m^3/s. An answer in the affirmative indicates selection of strategy W2. Had that been done, it is not clear whether there would have been any change to the Wivenhoe Dam releases. This issue may apply to some succeeding periods but will not be addressed again.

Period 5 of 20 - 1400h on 8 January to 0100h on 9 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	68.61 to 68.63 (A) 68.7 (P) 68.9 (PF)	Complies on actual and predicted.
Flow at Lowood (m^3/s)	No restriction	530+1,240=1,770 (P) 530+1,240=1,770 (PF)	Not applicable
Flow at Moggill (m^3/s)	< 4,000	770+1,240=2,010 (P) 840+1,240=2,080 (PF)	Complies
Peak release (m^3/s)	< 4,000	1,240	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	100.44 to 100.32 (A) 100.5 (P) 100.6 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	68.61 to 68.63 (A) 68.7 (P) 68.9 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Period 6 of 20 - 0100h on 9 January to 0800h on 9 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	68.63 to 68.56 (A) 68.7 (P) 69.3 (PF)	Complies on actual and predicted.
Flow at Lowood (m^3/s)	No restriction	530+1,334=1,864 (P) 530+1,334=1,864 (PF)	Not applicable
Flow at Moggill (m^3/s)	< 4,000	770+1,334=2,104 (P) 780+1,334=2,114 (PF)	Complies
Peak release (m^3/s)	< 4,000	1,334	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	100.32 to 100.28 (A) 100.5 (P) 101.0 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	68.63 to 68.56 (A) 68.7 (P) 69.3 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Period 7 of 20 - 0800h on 9 January to 1400h on 9 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	68.56 to 68.58 (A) 70.0 (P) 71.3 (PF)	Complies on actual and predicted.
Flow at Lowood (m^3/s)	No restriction	530+1,386=1,916 (P) 690+1,386=2,076 (PF)	Not applicable
Flow at Moggill (m^3/s)	< 4,000	770+1,386=2,156 (P) 1,210+1,386=2,596 (PF)	Complies
Peak release (m^3/s)	< 4,000	1,386	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	100.28 to 100.47 (A) 100.7 (P) 101.1 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	68.56 to 68.58 (A) 70.0 (P) 71.3 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Period 8 of 20 - 1400h on 9 January to 1900h on 9 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	68.58 to 68.97 (A) 72.1 (P) 73.9 (PF)	Complies on actual and predicted.
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	< 4,000	3,300 (P) 4,400 (PF)	Prediction with forecast exceeds the limit – Manual recognizes flow may exceed the limit, with an aim to get below the limit as soon as possible
Peak release (m^3/s)	< 4,000	1,411	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	100.47 to 101.43 (A) 102.3 (P) 103.0 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	68.58 to 68.97 (A) 72.1 (P) 73.9 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Period 9 of 20 - 1900h on 9 January to 0100h on 10 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	68.97 to 69.90 (A) 72.9 (P) 74.7 (PF)	Does not comply on forecast prediction but does on actual. Taken as a compliance due to ambiguity of the Manual.
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	< 4,000	3,240 (P) 4,480 (PF)	Prediction with forecast exceeds the limit – Manual recognizes flow may exceed the limit, with an aim to get below the limit as soon as possible
Peak release (m^3/s)	< 4,000	1,473	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	101.43 to 102.54 (A) 102.9 (P) 103.4 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	68.97 to 68.90 (A) 72.9 (P) 74.7 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Note: It is noted that the level in the Wivenhoe reservoir was now predicted to be EL74.7m, based on forecast, which exceeds the threshold that would move the strategy to W4. But the strategy over this period remained W3. This is not considered a non-compliance because paragraph 3 of sub-section 8.4 of the Manual seems to give the operator the discretion to consider the actual reservoir level, which did not exceed EL68.90 during the period. The information is not available to judge whether point 4 of the strategy provided optimum protection for urban areas as required by sub-section 3.1 of the Manual.

Period 10 of 20 - 0100h on 10 January to 0900h on 10 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	69.97 to 71.56 (A) 72.9 (P) 74.5 (PF)	Does not comply on forecast prediction but does on actual. Taken as a compliance due to ambiguity of the Manual.
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	< 4,000	3,420 (P) 4,680 (PF)	Prediction with forecast exceeds the limit – Manual recognizes flow may exceed the limit, with an aim to get below the limit as soon as possible
Peak release (m^3/s)	< 4,000	2,015	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	102.54 to 103.08 (A) 103.1 (P) 103.5 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	69.97 to 71.56 (A) 72.9 (P) 74.5 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Note: It is noted that the level in the Wivenhoe reservoir was now predicted to be EL74.5m, based on forecast, which exceeds the threshold that would move the strategy to W4. But the strategy over this period remained W3. This is not considered a non-compliance because paragraph 3 of sub-section 8.4 of the Manual seems to give the operator the discretion to consider the actual reservoir level, which did not exceed EL71.56 during the period. The information is not available to judge whether point 5 of the strategy provided optimum protection for urban areas as required by sub-section 3.1 of the Manual.

Period 11 of 20 - 0900h on 10 January to 1500h on 10 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	71.56 to 72.54 (A) 73.6 (P) 75.2 (PF)	Does not comply on forecast prediction but does on actual. Taken as a compliance due to ambiguity of the Manual.
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	< 4,000	3,910 (P) 5,180 (PF)	Prediction with forecast exceeds the limit – Manual recognizes flow may exceed the limit, with an aim to get below the limit as soon as possible
Peak release (m^3/s)	< 4,000	2,087	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	103.08 to 103.43 (A) 103.4 (P) 103.7 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	71.56 to 72.54 (A) 73.6 (P) 75.2 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Note: It is noted that the level in the Wivenhoe reservoir was now predicted to be EL75.2m, based on forecast, which exceeds the threshold that would move the strategy to W4. But the strategy over this period remained W3. This is not considered a non-compliance because paragraph 3 of sub-section 8.4 of the Manual seems to give the operator the discretion to consider the actual reservoir level, which did not exceed EL72.54 during the period. The information is not available to judge whether point 4 of the strategy provided optimum protection for urban areas as required by sub-section 3.1 of the Manual.

Period 12 of 20 - 1500h on 10 January to 2000h on 10 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	72.53 to 73.06 (A) 73.6 (P) 74.3 (PF)	Does not comply on forecast prediction but does on actual. Taken as a compliance due to ambiguity of the Manual.
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	< 4,000	3,980 (P) 4,470 (PF)	Prediction with forecast exceeds the limit – Manual recognizes flow may exceed the limit, with an aim to get below the limit as soon as possible
Peak release (m^3/s)	< 4,000	2,695	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	103.43 to 103.45 (A) 103.5 (P) 103.5 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	72.53 to 73.06 (A) 73.6 (P) 74.3 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Note: It is noted that the level in the Wivenhoe reservoir was now predicted to be EL74.3m, based on forecast, which exceeds the threshold that would move the strategy to W4. But the strategy over this period remained W3. This is not considered a non-compliance because paragraph 3 of sub-section 8.4 of the Manual seems to give the operator the discretion to consider the actual reservoir level, which did not exceed EL73.06 during the period. Moreover, shortly after the start of the next period the Regulator, in accordance with sub-section 2.8 of the Manual, had agreed that the actual level could exceed EL74.0m for a period less than 12 hours without moving to Strategy W4. The actual level did not reach EL74.0 for

about another 14.5 hours. The information is not available to judge whether point 5 of the strategy provided optimum protection for urban areas as required by sub-section 3.1 of the Manual.

Period 13 of 20 - 2000h on 10 January to 0400h on 11 January – Strategy W3/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	73.06 to 73.40 (A) 74.1 (P) 74.9 (PF)	Does not comply on both predictions but does on actual level. Taken as a compliance due to ambiguity of the Manual.
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	< 4,000	4,040 (P) 4,540 (PF)	Prediction with forecast exceeds the limit – Manual recognizes flow may exceed the limit, with an aim to get below the limit as soon as possible
Peak release (m^3/s)	< 4,000	2,726	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	103.45 to 103.23 (A) 103.5 (P) 103.7 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	73.06 to 73.40 (A) 74.1 (P) 74.9 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Note: It is noted that the level in the Wivenhoe reservoir was now predicted to be above EL74.1m, which exceeds the threshold that would move the strategy to W4. But the strategy over this period remained W3. This is not considered a non-compliance because paragraph 3 of sub-section 8.4 of the Manual seems to give the operator the discretion to consider the actual reservoir level, which did not exceed EL73.40 during the period. The information is not available to judge whether point 4 of the strategy provided optimum protection for urban areas as required by sub-section 3.1 of the Manual.

Period 14 of 20 - 0400h on 11 January to 0800h on 11 January – Strategy W3/S2 (my conclusion as to the intended meaning of the draft Report)

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	68.50 to 74.00	73.40 to 73.70 (A) 74.5 (P) 75.1 (PF)	Does not comply on both predictions but does on actual. Taken as a compliance due to ambiguity of the Manual.
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	< 4,000	5,870 (P) Not available (PF)	Prediction with forecast exceeds the limit – Manual recognizes flow may exceed the limit, with an aim to get below the limit as soon as possible
Peak release (m^3/s)	< 4,000	2,832	Complies

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	103.23 to 103.46 (A) 103.9 (P) 104.2 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	73.40 to 73.70 (A) 74.5 (P) 75.1 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. My interpretation is that the releases complied with the Manual. There is an element of doubt about releases because the heading in the "Strategy" column clearly implies that strategy W4 applied throughout this period. If that were correct, point 3 of the "Background" column records a non-compliance because discharge was constant over the period whereas strategy W4 requires increasing discharge until the reservoir level commences to fall. However, point 2 of the "Strategy" column states the decision to go to strategy W4 was made at 0800h – that is, at the end of the period. The conclusion is that strategy W3 applied throughout this period and the heading of the "Strategy" column is simply incorrect. In that case there was no non-compliance.

Note: It is noted that the level in the Wivenhoe reservoir was now predicted to be EL74.5m or higher, which exceeds the threshold that would move the strategy to W4. But the strategy over this period appears to have remained W3. This is not considered a non-compliance because paragraph 3 of sub-section 8.4 of the Manual seems to give the operator the discretion to consider the actual reservoir level, which did not exceed EL73.70 during the period.

Period 15 of 20 - 0800h on 11 January to 1300h on 11 January – Strategy W4/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	> 74.00	73.70 to 74.39 (A) 75.0 (P) 76.2 (PF)	Complies
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	No limitation	Not available	Not applicable
Peak release (m^3/s)	No limitation	4,250	Not applicable

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	103.46 to 103.83 (A) 104.8 (P) 105.7 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	73.70 to 74.39 (A) 75.0 (P) 76.2 (PF)	Complies on actual and predicted but not on forecast predicted. Taken to be a compliance because of ambiguity in the Manual.

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Note: It is noted that the level in the Wivenhoe reservoir was now predicted, on the basis of forecast, to be above EL75.5m, which exceeds the threshold that would move the Somerset strategy to S3. But the strategy over this period remained S2. This is not considered a non-compliance because paragraph 3 of sub-section 8.4 of the Manual seems to give the operator the discretion to consider the actual reservoir level, which did not exceed EL74.39 during the period.

Period 16 of 20 - 1300h on 11 January to 1900h on 11 January – Strategy W4/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	> 74.00	74.39 to 74.97 (A) 75.0 (P) 75.2 (PF)	Complies
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	No limitation	Not available	Not applicable
Peak release (m^3/s)	No limitation	7,464	Not applicable

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	103.83 to 104.60 (A) 105.2 (P) 105.9 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	74.39 to 74.97 (A) 75.0 (P) 75.2 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Period 17 of 20 - 1900h on 11 January to 2100h on 11 January – Strategy W4/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	> 74.00	74.97 to 74.95 (A) 75.0 (P) 75.2 (PF)	Complies
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	No limitation	Not available	Not applicable
Peak release (m^3/s)	No limitation	7,458	Not applicable

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	104.60 to 104.78 (A) 105.2 (P) 105.9 (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	74.97 to 74.95 (A) 75.0 (P) 75.2 (PF)	Complies on actual and predicted

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Period 18 of 20 - 2100h on 11 January to 0800h on 12 January – Strategy W4/S2

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	> 74.00	74.97 to 74.78 (A) Not available (P) Not available (PF)	Complies
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	No limitation	Not available	Not applicable
Peak release (m^3/s)	No limitation	7,464 to 2,547	Not applicable

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	> 99.0	104.78 to 105.11 (A) Not available (P) Not available (PF)	Complies
Wivenhoe lake level (m AHD)	67.00 to 75.50	74.97 to 74.78 (A) Not available (P) Not available (PF)	Complies

Conclusion: The strategy complied with the Manual. The releases complied with the Manual.

Period 19 of 20 - 0800h on 12 January to 1200h on 13 January – Drain Down Phase

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	= 67.00 within seven days (subject to base flow allowance)	74.78 to 74.61 (A)	Compliance not yet known
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	No limitation	Not available	Not applicable
Release (m^3/s)	No limitation	2,534	Not applicable

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	= 99.00 within seven days (subject to base flow allowance)	105.11 to 103.96 (A)	Compliance not yet known
Wivenhoe lake level (m AHD)	67.00 to 75.50	74.78 to 74.61 (A)	Complies on actual and predicted

Conclusion: There was no violation of the Manual requirements during the period.

Period 20 of 20 - 1200h on 13 January to 1200h on 19 January - Drain Down Phase

Wivenhoe Dam

Factor	Range from Manual	Actual values	Conclusion
Lake level (m AHD)	= 67.00 within seven days (subject to base flow allowance)	74.61 to 66.89 (A)	Effective compliance
Flow at Lowood (m^3/s)	No restriction	Not available	Not applicable
Flow at Moggill (m^3/s)	No limitation	Not available	Not applicable
Release (m^3/s)	Avoidance of adverse impacts on river system below 4,000 m^3/s	Not available	Not applicable

Somerset Dam

Factor	Range from Manual	Actual values	Conclusion
Somerset lake level (m AHD)	= 99.00 within seven days (subject to base flow allowance)	103.96 to 99.00 (A)	Effective compliance
Wivenhoe lake level (m AHD)	Not applicable	74.61 to 66.89 (A)	Not applicable

Conclusion: The releases complied with the Manual.

Question 2 - were there any aspects relating to the operation of Wivenhoe Dam and the operation of Somerset Dam during the January 2011 Flood Event not in accordance with the Manual?

1. **Releases from Wivenhoe Dam**

   Under the preceding question there is the explanation of a possible non-compliance with the Manual at period 4 in not implementing strategy W2. There is uncertainty because of ambiguity in the Manual.

2. **Operational arrangements**

   Seqwater complied with the six requirements of sub-section 2.2 of the Manual – see sub-section 3.2 of the draft Report.

3. **Provision of flood operations engineers**

   Seqwater provided engineers with duties as required by sub-sections 2.2 and 2.3 of the Manual – see sub-section 3.2 of the draft Report.

4. **Qualifications and experience of flood operations personnel**

   The qualifications and experience of the flood operations engineers have been approved by the Chief Executive as required by sub-section 2.5 of the Manual – see sub-section 3.3 of the draft Report.

5. **Schedule of authorities**

   The schedule was provided to the Regulator on 4 October 2010 as required by sub-section 2.6 of the Manual.

6. **Training**

   Flood operations personnel have received training as required by sub-section 2.7 of the report – see sub-section 3.3 of the draft Report. A report was provided to the Chief Executive on 4 October 2010 detailing the training personnel had received and their state of readiness – as required by sub-section 7.2 of the Manual.

7. **Reasonable Discretion**

   The procedure of sub-section 2.8 of the Manual was followed – see period 13 of the Flood Event Summary, Section 2, the draft Report.

8. **Report of flood event**

   The draft Report was provided to the Chief Executive on 2 March 2011 (e-mail of 0807h on 8 March 2011 from Mr Jim Pruss), which complies with sub-section 2.9 of the Manual.

9. **Maintenance of RTFM**

As required by sub-sections 5.2 and 7.3 of the Manual, the reliability of the RTFM system was reviewed by Seqwater and reported to the Regulator on 4 October 2010.

10. Data collection log

Referring to sub-section 5.2 of the Manual, the reliability of the data collection system was reviewed by Seqwater and was reported to the Regulator on 4 October 2010.

So far as can be seen the draft Report does not say whether a data collection log is kept.

11. RTFM performance log

So far as can be seen the draft Report does not say whether an RTFM log is kept.

12. Manual reading of gauge boards

Manual reading was available as required by sub-section 5.4 of the Manual – see period 15, Flood Event Summary, section 2, draft Report.

13. Sharing of field station calibration with other agencies

So far as can be seen the draft Report does not say whether field station calibrations are shared with the relevant stakeholders.

14. Reliable communication

Seqwater provided reliable communication channels as required by sub-section 6.1 of the Manual – see sub-section 4.2 of the draft Report.

15. Dissemination of information

As required by sub-section 6.2 of the Manual, Seqwater advised relevant stakeholders of releases from the dams and other pertinent information – see sub-section 4.3 of the draft Report.

16. Review of Manual procedures

The draft Report, provided to the Chief Executive on 2 March 2011, contains a review of Manual procedures required by sub-section 7.4 of the Manual.